

Please read the questions very carefully to understand what is being asked. If you do not understand anything, please ask your instructor. Use the reverse side of your question paper as scratch. No outside paper is allowed. You can use the periodic table and constant data provided. Total points =  $60 + (17 * 3) = 111$

**SHORT ANSWER.** Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

- 1) Show your calculation to get correct answer (reported to the proper number of significant figures) for the following: (4 pts.)

1)  $6 \times 10^2$

$$(1815-1806) \times (9.11 \times 7.92) = (9)(9.11)(7.92) = \underline{649.3608} = 6 \times 10^2$$

- 2) Show calculations with units to convert 6.32 cm into inches (1 in = 2.54 cm.). (4 pts.)

2) 2.49 in

$$\begin{aligned} ? \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}} &= ? \text{ in} \\ 6.32 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}} &= \underline{2.488188976} \text{ in} \end{aligned}$$

- 3) Calculate (with units) how many  $\text{in}^3$  are in  $2.20 \text{ cm}^3$  (1 in = 2.54 cm.)? (8 pts.)

3)  $0.134 \text{ in}^3$

$$\begin{aligned} (1 \text{ in})^3 &= (2.54 \text{ cm})^3 \rightarrow ? \text{ cm}^3 \times \left(\frac{1 \text{ in}}{2.54 \text{ cm}}\right)^3 = ? \text{ in}^3 \\ 1 \text{ in}^3 &= 16.4 \text{ cm}^3 \\ 2.20 \text{ cm}^3 \times \frac{1 \text{ in}^3}{16.4 \text{ cm}^3} &= \underline{0.134146341} \text{ in}^3 \end{aligned}$$

4) Calculate the number of moles of Cu in  $1.48 \times 10^{25}$  Cu atoms. (6 pts.)

4) 24.6 mol Cu

$$\begin{aligned}
 & ? \text{ atoms Cu} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} = ? \text{ mol Cu} \\
 1.48 \times 10^{25} \text{ atoms Cu} & \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} = \frac{1.48 \times 10^{25}}{6.022 \times 10^{23}} \text{ mol Cu} \\
 & = 24.6 \text{ mol Cu}
 \end{aligned}$$

5) A fictional element has three isotopes with their natural abundances shown as:

5) 22.83 amu

MASS (amu)	ABUNDANCE
22.1760	45.00%
23.1847	45.00%
24.1934	10.00%

Show your calculation to determine the atomic mass of the element (6 pts.).

$$\begin{aligned}
 \text{Atomic mass} &= (\text{mass of isotope 1})(\% \text{ abundance} / 100) + (\text{mass of isotope 2})(\% \text{ abundance} / 100) + (\text{mass of isotope 3})(\% \text{ abundance} / 100) \\
 &= (22.1760 \text{ u})(45.00\% / 100) + (23.1847)(45.00\% / 100) + (24.1934)(10.00\% / 100) \\
 &= (22.1760 \text{ u})(0.4500) + (23.1847)(0.4500) + (24.1934)(0.1000) \\
 &= 9.9792 \text{ u} + 10.433115 \text{ u} + 2.41934 \text{ u} \\
 &= 22.831655 \text{ u} \\
 &= 22.83 \text{ u}
 \end{aligned}$$

6) Calculate the amount (in grams) of phosphorous in a 15.5 gram sample of diphosphorous pentoxide. (8 pts.)

6) 6.76 g P

$$\begin{aligned}
 & 4 \text{ P} + 5 \text{ O}_2 \rightarrow 2 \text{ P}_2\text{O}_5 \\
 x \text{ g P}_2\text{O}_5 & \times \frac{1 \text{ mol P}_2\text{O}_5}{? \text{ g P}_2\text{O}_5} \times \frac{4 \text{ mol P}}{2 \text{ mol P}_2\text{O}_5} \times \frac{? \text{ g P}}{1 \text{ mol P}} = ? \text{ g P} \\
 15.5 \text{ g P}_2\text{O}_5 & \times \frac{1 \text{ mol P}_2\text{O}_5}{141.94 \text{ g P}_2\text{O}_5} \times \frac{4 \text{ mol P}}{2 \text{ mol P}_2\text{O}_5} \times \frac{30.97 \text{ g P}}{1 \text{ mol P}} = 6.76391433 \text{ g P}
 \end{aligned}$$

$$\begin{aligned}
 & \text{P: } 2 \times 30.97 \\
 & \text{O: } 5 \times 16.00 \\
 & \hline
 & 141.94 \text{ g P}_2\text{O}_5
 \end{aligned}$$

7) An acid has 40% C, 6.7% H, 53.3% O and its molar mass is 60.05 g/mol. Show your calculation to find the molecular formula of the acid. (10 pts.)

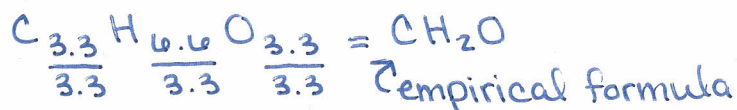
7) C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>

Assume 100g sample, find mol of each element.

$$40 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 3.3 \text{ mol C}$$

$$6.7 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 6.6 \text{ mol H}$$

$$53.3 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 3.3 \text{ mol O}$$



$$\text{Integer} = \frac{\text{compound g/mol}}{\text{emp. form. g/mol}} = \frac{60.05 \text{ g/mol}}{30.03 \text{ g/mol}} = 1.99 = 2$$

Molecular formula = (integer)(empirical formula) = (2)(CH<sub>2</sub>O) = C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>

8) In the reaction Fe<sub>2</sub>O<sub>3</sub> (s) + 2Al (s) → 2Fe (s) + Al<sub>2</sub>O<sub>3</sub> (s), 23.5 g of Fe<sub>2</sub>O<sub>3</sub> was reacted with 13.2 g of Al. (a) Show all your calculations to find out the limiting reagent (8 pts.)

8) (a) Fe<sub>2</sub>O<sub>3</sub>

$$\text{Fe: } 2 \times 55.85$$

$$\text{O: } 3 \times 16.00$$

$$\hline 159.70$$

Find mol Al<sub>2</sub>O<sub>3</sub> from 23.5 g Fe<sub>2</sub>O<sub>3</sub>.

$$23.5 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.70 \text{ g Fe}_2\text{O}_3} \times \frac{1 \text{ mol Al}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = 0.147 \text{ mol Al}_2\text{O}_3$$

↑ limiting reagent

Find mol Al<sub>2</sub>O<sub>3</sub> from 13.2 g Al.

$$13.2 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{1 \text{ mol Al}_2\text{O}_3}{1 \text{ mol Al}} = 0.489 \text{ mol Al}_2\text{O}_3$$

(b) Calculate the amount of reagent that remained in excess (6 pts.)

(b) 5.3 g  
9.23 g Al

Find g of Al needed to react with 23.5 g Fe<sub>2</sub>O<sub>3</sub>.

$$23.5 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.70 \text{ g Fe}_2\text{O}_3} \times \frac{2 \text{ mol Al}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = 3.97 \text{ g Al} \times 2 = 7.94 \text{ g Al}$$

Find excess of Al if 13.2 g Al was used.

$$\begin{array}{r} 13.2 \text{ g} \\ - 3.97 \text{ g} \\ \hline 9.23 \text{ g Al in excess} \end{array}$$

$$\begin{array}{r} \text{Initial } 13.2 \text{ g} \\ \text{Reacted } - 7.94 \text{ g} \\ \hline \text{Unreacted} = 5.26 \end{array}$$

**MULTIPLE CHOICE.** On scantron, answer by filling the bubbles of the same number as the question number. Choose the one alternative that best completes the statement or answers the question. (3 points each)

9) In the periodic table, the rows are called periods and the columns are called groups. 9) A  
 A) periods, groups  
 B) octaves, groups  
 C) rows, groups  
 D) staffs, families  
 E) cogeners, families

10) The element barium is the most similar to strontium in chemical and physical properties. 10) A  
 A) Ba       B) Li       C) Cs       D) At       E) Rb

11) What is the formula of the compound formed between strontium ions <sup>+2</sup> and nitrogen ions <sup>-3</sup>? 11) B  
 A) SrN<sub>2</sub>       B) Sr<sub>3</sub>N<sub>2</sub>       C) SrN<sub>3</sub>       D) SrN       E) Sr<sub>2</sub>N<sub>3</sub>

12) Aluminum reacts with a certain nonmetallic element to form a compound with the general formula AlX. Element X is a diatomic gas at room temperature. Element X must be 12) E  
 A) chlorine       B) sulfur       C) fluorine       D) oxygen       E) nitrogen <sup>-3</sup>

13) Sulfur forms an ion with a charge of \_\_\_\_\_. 13) A  
 A) 2-       B) 6-       C) 6+       D) 2+       E) 3+

14) The correct name for  $K_2S$  is \_\_\_\_\_. 14) C  
 A) potassium sulfate  
 B) potassium disulfide  
 C) potassium sulfide  
 D) dipotassium sulfate  
 E) potassium bisulfide  
*metal*  
*nonmetal*

15) Which pair of atoms constitutes a pair of isotopes of the same element? 15) E  
 A)  ${}_{9}^{17}X$      ${}_{8}^{17}X$   
 B)  ${}_{10}^{19}X$      ${}_{9}^{19}X$   
 C)  ${}_{6}^{14}X$      ${}_{7}^{14}X$   
 D)  ${}_{10}^{20}X$      ${}_{11}^{21}X$   
 E)  ${}_{6}^{14}X$      ${}_{6}^{12}X$

16) The correct name for  $N_2O_5$  is \_\_\_\_\_.

- A) dinitrogen pentoxide
- B) nitrogen oxide
- C) nitrogen pentoxide
- D) nitric oxide
- E) nitrous oxide

16) A

17) The correct name for  $HClO_3$  is \_\_\_\_\_.

- A) perchloric acid
- B) hydrochloric acid
- C) chloric acid
- D) chlorous acid
- E) hydrochlorous acid

17) C

18) The correct formula of iron(III) bromide is  $FeBr_3$ .

- A)  $FeBr_3$
- B)  $FeBr_2$
- C)  $Fe_3Br$
- D)  $Fe_3Br_3$
- E)  $FeBr$

18) A

19) Chromium and chlorine form an ionic compound whose formula is  $CrCl_3$ . The name of this compound is \_\_\_\_\_.

- A) chromium chlorine
- B) monochromium trichloride
- C) chromium(III) chloride
- D) chromic trichloride
- E) chromium(III) trichloride

19) C

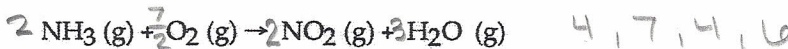
20) What is the volume (in  $cm^3$ ) of a 63.4 g piece of metal with a density of  $12.86 g/cm^3$ ?

- A) 4.93
- B) 6.65
- C) 19.5
- D) .425
- E) none of the above

$D = \frac{m}{V}$   
 $V = \frac{m}{D}$   
 $V = \frac{63.4 g}{12.86 g/cm^3} = \frac{63.4}{12.86} cm^3 = 4.93 cm^3$

20) A

21) When the following equation is balanced, the coefficients are \_\_\_\_\_.



- A) 1, 1, 1, 1
- B) 1, 3, 1, 2
- C) 4, 7, 4, 6
- D) 4, 3, 4, 3
- E) 2, 3, 2, 3

21) C

22) The formula weight of calcium nitrate ( $Ca(NO_3)_2$ ), rounded to one decimal place, is \_\_\_\_\_ amu.

- A) 204.2
- B) 150.1
- C) 116.1
- D) 102.1
- E) 164.0

$Ca: 40.08 \times 1 = 40.08$   
 $N: 14.01 \times 2 = 28.02$   
 $O: 16.00 \times 6 = 96.00$   
164.10

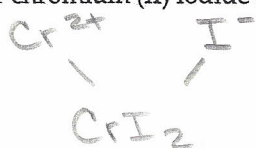
22) E

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer.

23) There are 6 significant figures in the number 0.003702.

23) F

24) The formula for chromium (II) iodide is  $CrI_2$ .



24) T

25) The quantity of product that is calculated to form when all of the limiting reagent reacts is called the actual yield.

*theoretical*

25) F

**SHORT ANSWER.** Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

26) EXTRA POINT QUESTION: Calculate the number of atoms in 5.80 moles of He? (4 pts.)

26) 3.49 <sup>10<sup>24</sup></sup> atoms He

$$\begin{aligned} & ? \text{ moles He} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ moles}} = ? \text{ atoms He} \\ -1 & 5.80 \text{ mol He} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = 3.49 \times 10^{24} \text{ atoms He} \end{aligned}$$